

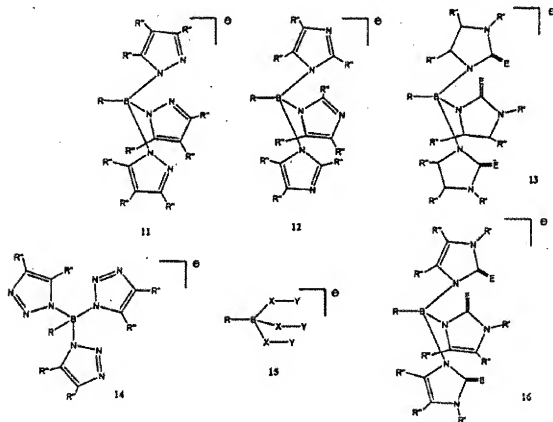
Amendments to the Claims

This listing of claims replaces all previous versions, and prior listing, which have been submitted in the application:

1. (Withdrawn) A method for altering the electrical characteristics of an organic semiconducting matrix material, the method comprising doping the organic semiconducting matrix material with a metal complex dopant, wherein the metal complex is an n-dopant with regard to the matrix material.
2. (Withdrawn) The method as recited in claim 1, wherein said organic semiconducting matrix material has a central atom selected from the group consisting of a neutral transition metal atom and a charged transition metal atom.
3. (Withdrawn) The method as recited in claim 2, wherein at least one said central atom of said metal complex has a formal number of valence electrons of 16 or more and/or said metal complex is polynuclear and has at least one metal-metal bond between two said metal central atoms of said metal complex.
4. (Withdrawn) The method as recited in claim 3, wherein said at least one central atom is bound to a ligand comprising at least one donor atom that is different from an aromatic nitrogen atom as a component of a 6-membered ring.
5. (Withdrawn) The method as recited in claim 4, wherein at least one of said at least one donor atoms binding to said ligand of said central atom is selected from the group consisting of: B, Al, Ga, In, C, Si, Ge, Sn, Pb, P, As, Sb, Bi, S, Se, Te.
6. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand forms a π complex with said central atom of said metal complex.

7. (Withdrawn) The method as recited in claim 4, wherein said metal complex is a polynuclear metal complex in which at least one of said ligand coordinates to at least two of said metal central atoms.
8. (Withdrawn) The method as recited in claim 4, wherein at least one of said ligands of said metal complex is selected from the group consisting of: halides, carboxylates, formamidinates, pyrimido-pyrimidines, hpp and guanidinates.
9. (Withdrawn) The method as recited in claim 4, wherein at least one of said ligands of said metal complex belongs to the group consisting of: borates, carboranes, triazacycloalkanes, triazacycloalkenes, pyrroles, thiophenes, pyrazoles, imidazoles, thiazoles, oxazoles and fullerenes.

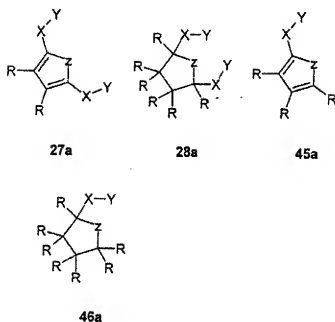
10. (Withdrawn) The method as recited in claim 9, wherein at least one borate ligand is selected from the group consisting of the following compounds: 11, 12, 13, 14, 16; wherein R, R', and R'', independently of one another, are any substituent, including hydrogen; and wherein R, R' and R'' can be the same or different in each case; and wherein E is an at least divalent atom or group of atoms:



11. (Withdrawn) The method as recited in claim 4, wherein said at least one donor atom binding to said at least one metal central atom is a carbanion-carbon atom or, with regard to said ligand, a formally divalent atom selected from the group consisting of: C (carbene), Si (silylene), Ge (germylene), Sn, Pb.

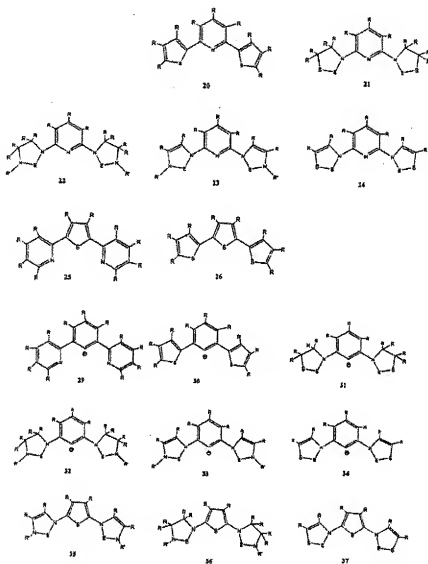
12. (Withdrawn) The method as recited in claim 11, wherein said formally divalent atom is a component of an aromatic or non-aromatic ring, wherein said ring further possesses the donor atom, and wherein said donor atom further possesses a heteroatom selected from the group consisting of: N, P, As, S, Se or Te.

13. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is a compound having a formula selected from the group consisting of: 27, 27a, 28, 28a, 45, 45a, 46 or 46a;



wherein R is, in each case and independently of one another, any substituent, including hydrogen; wherein X is a heteroatom or carbon atom capable of acting as a donor; wherein X is an at least divalent atom or group of atoms; wherein one or two X can also be missing; wherein Z and Y are in each case a carbon or heteroatom capable of acting as a donor; and wherein Z and Y and two Y atoms can be the same as one another or different from one another in each case.

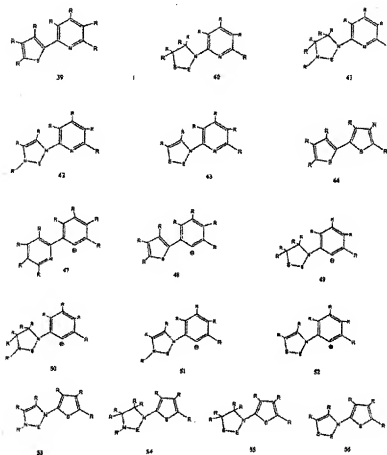
14. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is a compound selected from the group consisting of: 20-26, 29-37; wherein R is, in each case and independently of one another, any substituent, including hydrogen; wherein E is an atom selected



from the group consisting of: C, Si, Ge, Sn, Pb; wherein in each case P, As or Sb can be present, independently of one another, instead of N; and wherein Se or Te can be present, in each case independently of one another, instead of S.

15. (Withdrawn) The method as recited in claim 14, wherein E is selected from the group consisting of: C (carbene), Si (silylene), and Ge (germylene).

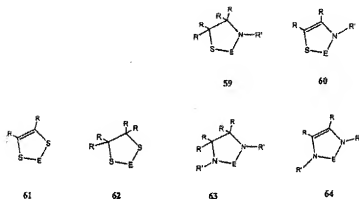
16. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is a compound selected from the group consisting of: 39-44, 47-56;



wherein R is, in each case and independently of one another, any substituent, including hydrogen; wherein R and R' can be the same or different; wherein E is an atom selected from the group consisting of: C, Si, Ge, Sn, Pb; wherein X is a heteroatom or carbon atom capable of acting as a donor, and in each case independently of one another, P, As or Sb can be present instead of N; and wherein Se or Te can be present, in each case independently of one another, instead of S.

17. (Withdrawn) The method as recited in claim 15, wherein E is selected from the group consisting of: C (carbene), Si (silylene), and Ge (germylene).

18. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is selected from the group consisting of: compounds 59, 60, 61, 62, 63 and 64;



wherein R is, in each case and independently of one another, any substituent, including hydrogen; wherein E is an atom selected from the group consisting of: C, Si, Ge, Sn, Pb; wherein X is a heteroatom or carbon atom capable of acting as a donor; wherein P, As or Sb can be present instead of N, independently of one another in each case; and wherein Se or Te can be present instead of S, independently of one another in each case.

19. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is selected from the group consisting of: compounds 19, 38, 57 or 58; wherein R is, in each case and independently of one another, any substituent, including hydrogen; wherein X is a heteroatom or carbon atom capable of acting as a donor; and wherein P, As or Sb can be used instead of N, independently of one another in each case.

20. (Withdrawn) The method as recited in claim 12, wherein at least one of said rings carrying said donor atom has at least one or more substituted or unsubstituted alkyl substituents with C2-C20.

21. (Withdrawn) The method as recited in claim 4, wherein at least one said ligand is a tripod ligand having the general structure:



wherein R is any substituent, including H; wherein R can be identical to the structural sequence –X-Y; wherein X represents an at least divalent atom or a group of atoms with or without heteroatoms; wherein X can be the same or different in each case; wherein Y is a heteroatom or carbon atom capable of acting as a donor; wherein Y can be the same or different and can be part of a ring; and wherein Z, as the central atom of said tripod ligand, can be any atom, including a metal atom.

22. (Withdrawn) The method as recited in claim 21, wherein said Y heteroatom is selected from the group consisting of: C, N, P, S, Se, Ge, and Sn.

23. (Withdrawn) The method as recited in claim 1, wherein said metal complex is selected from the group comprising: M_2hpp_4 , with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; $M_2(AlkylCOO)_4F$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W and with alkyl in each case, the same as each other or different from one another, with C1 to C10; $M_2(\text{guanidinate})_4$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; $M_2(\text{formamidinate})_4$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; $M_2(\text{carboxylate})_4$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; $M_2(\text{halide})_4$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; $bis(\eta^5\text{-cyclopentadienyl})M$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W; and benzene- $M-(\eta^5\text{-cyclopentadienyl})$ with M selected from the group comprising: Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W.

24. (Withdrawn) The method as recited in claim 4, wherein said ligand contains one or more hydrogen atoms and wherein said hydrogen atoms are replaceable by residues, including alkyl residues.

25. (Withdrawn) The method as recited in claim 1, wherein said metal complex has an ionization potential in the gas phase of less than 6 eV.

26. (Withdrawn) The method as recited in claim 1, wherein said metal complex has an oxidation potential of $E(1/2)_{ox}$ against ferrocene/ferrocenium (Fe/Fe^+) of ≤ -0.09 V.

27. (Withdrawn) A product comprising an organic semiconducting material disposed on a substrate, wherein the organic semiconducting material is a semiconducting matrix material doped with a metal complex dopant, and

wherein said organic semiconducting material is disposed of at least one of an electrically contactable layer and an electrical line path arranged on a substrate.

28. (Withdrawn) The product as recited in claim 27, wherein said organic semiconducting material contains at least one organic matrix compound and an n-dopant, and wherein said n-dopant comprises at least one neutral metal complex.

29. (Withdrawn) The product as recited in claim 28, wherein the molar doping ratio of n-dopant to said organic matrix compound or the doping ratio of said dopant to monomeric units of a polymeric matrix molecule is between about 1:1 and about 1:100,000.

30. (Withdrawn) A process for producing an organic semiconducting material, the process comprising doping an organic matrix molecule with an n-dopant,

wherein said n-dopant is comprised of at least one neutral metal complex.

31. (Withdrawn) A method for producing an electronic device, the method comprising forming an electronically functionally effective region containing a metal complex and an organic semiconducting material,

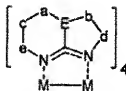
wherein said metal complex is a neutral electron-rich metal complex.

32. (Withdrawn) An electronic device having an electronically functionally effective region, wherein said electronically effective region comprises an organic semiconducting material and at least one neutral metal complex.

33. (Withdrawn) An electronic device as recited in claim 32, wherein said electronically effective region has an organic semiconducting matrix material which is doped with at least one n-dopant in order to alter the electronic characteristics of the organic semiconducting matrix materials using at least one neutral metal complexes.

34. (Withdrawn) An electronic device as recited in claim 32, wherein said device is in the form of one of the group consisting of: an organic light-emitting diode (OLED), a photovoltaic cell, and organic solar cell, an organic diode or an organic field effect transistor; wherein said organic semiconducting matrix material is doped with at least one neutral metal complex; and wherein said organic semiconducting matrix material represents said electronically effective part of said electronic device.

35. (Currently Amended) A ~~depanmetal complex~~ for doping an organic semiconducting matrix material having the ~~following~~ a structure selected from:



Type 65a

wherein a $[[=]]$ is $-CR_1R_2-$ or $-NR-$, b $[[=]]$ is $-CR_3R_4-$ or $-NR-$, c $[[=]]$ is $-CR_5R_6-$ or $-SiR_5R_6-$, d $[[=]]$ is $-CR_7R_8-$ or $-NR-$, and e $[[=]]$ is $-CR_9R_{10}-$ or $-NR-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9,$ and R_{10} are selected independently from, at the same time or independently of one another, H, C_1-C_{20} alkyl, C_1-C_{20} cycloalkyl, C_1-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, heteroaryl, $-NR_{2a}$ or $-OR$, preferably $R_4, R_5, R_6, R_7, R_9 = H$ and $R_2, R_3, R_6, R_8, R_{10} = C_1-C_{20}$ alkyl, C_1-C_{20} cycloalkyl, C_1-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, heteroaryl, $-NR_2$ or $-OR$, or optionally, a or b or e or d can be $-NR$ with wherein R $[[=]]$ is selected independently from C_1-C_{20} alkyl, C_1-C_{20} cycloalkyl, C_1-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, or heteroaryl, or at e, C is replaced by Si;

wherein the bonds b-d and c-e or b-d and a-c ~~can may~~, at the same time or independently of one another, be unsaturated,

wherein the bonds b-d, a-c, and c-e ~~can may~~, at the same time or independently of one another, becomprse part of a saturated or unsaturated ring system which ~~can may~~ also containcomprse ~~that~~ at least one heteroelement $[[s]]$ selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

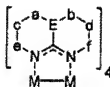
wherein the bonds b-d, a-c, and c-e ~~can may~~, at the same time or independently of one another becomprse part of an aromatic or condensed aromatic ring system which ~~can may~~ also comprse ~~that~~ at least one heteroelement $[[s]]$ selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group, preferably selected from the group N, P, As, Sb, though without being limited to these,

wherein the structural element a-E-b can comprise a component of a saturated or unsaturated ring system which can also contain the comprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, or

the structural element a-E-b can comprise a component of an aromatic ring system which can also contain the comprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, and N, [[.]]

wherein the metal M is a transition metal, preferably W or Mo;



Type 65b

wherein the structural elements a-f can mean: a [[=]] is -CR₁R₂- or -NR-, b [[=]] is -CR₃R₄- or -NR-, c [[=]] is -CR₅R₆- or -SiR₅R₆-, d [[=]] is -CR₇R₈- or -SiR₇R₈-, e [[=]] is -CR₉R₁₀- or -NR-, and f [[=]] is -CR₁₁R₁₂- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, and R₁₂ are selected independently from hydrogen, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, preferably R₁, R₃, R₅, R₇, R₉, R₁₁ = H and R₂, R₄, R₆, R₈, R₁₀, R₁₂ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, wherein the structure 65b with wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, and R₁₂ [[=]] are H being is excluded from this, or in the structural elements c and/or d, C can be replaced by Si,

wherein a or b or e or f can be -NR- with R [[=]] is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl, wherein

a and for b and c can be NR with $R = C_1-C_{20}$ alkyl, C_4-C_{20} cycloalkyl, C_3-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, heteroaryl,

wherein the bonds a-c, b-d, c-e, and d-f, but not simultaneously a-c and c-e and not simultaneously b-d and d-f, can may be unsaturated,

wherein the bonds a-c, b-d, c-e, and d-f can may becomprise part of a saturated or unsaturated ring system which can may also contain thecomprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

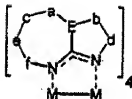
wherein the bonds a-c, b-d, c-e, and d-f can may becomprise part of an aromatic or condensed aromatic ring system which can may also contain thecomprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group, ~~selected from the group N, P, As, Sb, though without being limited to these,~~

wherein the structural element a-E-b can may becomprise a component of a saturated or unsaturated ring system which can may also contain thecomprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b can may becomprise a component of an aromatic ring system which can may also contain thecomprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, and N,

wherein the metal M is ~~one of W, Mo, and a transition metal~~[[,]],



Type 65c

wherein the structural elements a-f can mean: a [[=]] is -CR₁R₂- or -NR-, b [[=]] is -CR₃R₄- or -NR-, c [[=]] is -CR₅R₆- or -SiR₅R₆-, d [[=]] is -CR₇R₈- or -NR-, e [[=]] is -CR₉R₁₀- or -SiR₉R₁₀-, and f [[=]] is -CR₁₁R₁₂- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, and R₁₂ can, at the same time or independently from one another, be selected independently from [[H]] hydrogen, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR, wherein R is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl, preferably R₁, R₃, R₅, R₇, R₉, R₁₁ = H and R₂, R₄, R₆, R₈, R₁₀, R₁₂ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, wherein

at e or o, C can be replaced by Si;

wherein a or b or d or f can be NR with R = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, wherein

a and d or b and f can be NR with R = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl,

wherein the bonds a-c, c-e, e-f₂ and b-d, but not simultaneously a-c, c-e₂ and e-f₂ and not simultaneously a-c and c-e₂ and not simultaneously c-e and e-f₂ can may be unsaturated,

wherein the bonds a-c, c-e, e-f₂ and b-d can may comprise part of a saturated or unsaturated ring system which can may also contain the comprise at least one heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

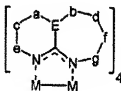
wherein the bonds a-c, c-e, e-f, and b-d ~~can~~ may comprise part of an aromatic or condensed aromatic ring system which ~~can~~ may also contain the comprise at least one heteroelement{[s]} selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group, ~~preferably selected from the group N, P, As, Sb, though without being limited to these,~~

wherein the structural element a-E-b ~~can optionally~~ may comprise a component of a saturated or unsaturated ring system which ~~can~~ may also contain the comprise at least one heteroelement{[s]} selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b ~~can optionally~~ may comprise a component of an aromatic ring system which ~~can~~ may also contain the comprise at least one heteroelement{[s]} selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal, ~~preferably W or Mo; or~~



Type 65d

wherein the structural elements a-g ~~can mean:~~ -a [[=]]is -CR₁R₂- or -NR-, b [[=]]is -CR₃R₄- or -NR-, c [[=]]is -CR₅R₆- or -SiR₅R₆-, d [[=]]is -CR₇R₈- or -SiR₇R₈-, e [[=]]is -CR₉R₁₀- or -NR-, f [[=]]is -CR₁₁R₁₂- or -SiR₁₁R₁₂-, and g [[=]]is -CR₁₃R₁₄- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, R₁₂, R₁₃, and R₁₄ ~~can, at the same time or independently from one another, be~~ are independently selected from H, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR, preferably, R₁, R₃, R₅, R₇, R₉, R₁₁, R₁₃ = H and R₂, R₄, R₆, R₈, R₁₀, R₁₂, R₁₄ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl,

aryl, heteroaryl, $-\text{NR}_2$ or $-\text{OR}$, or at e, d and f, though not wherein d and f cannot be simultaneously, C can be replaced by $-\text{Si}(\text{R}_7)_8-$ and $-\text{Si}(\text{R}_{11})\text{R}_{12}-$, respectively, wherein a or b or e or g can be NR with R [[=]] is selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, or heteroaryl,

wherein a and g or b and e can be NR with R = C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl,

wherein the bonds a-c, c-e, b-d, d-f, and f-g, but not simultaneously a-c and c-e, and not simultaneously b-d, d-f, and f-g, and not simultaneously b-d and d-f, and not simultaneously d-f and f-g, can may be unsaturated,

wherein the bonds a-c, c-e, b-d, d-f, and f-g can may comprise part of a saturated or unsaturated ring system, which can also contain may comprise at least one the heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the bonds a-c, c-e, b-d, and f-g can may comprise part of an aromatic or condensed aromatic ring system which can also contain may comprise at least one the heteroelement[[s]] selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group, ~~preferably selected from the group N, P, As, Sb, though without being limited to these,~~

wherein the structural element a-E-b can optionally may comprise a component of a saturated or unsaturated ring system which can also contain may comprise at least one the heteroelement[[s]] selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein the structural element a-E-b can may comprise a component of an aromatic ring system which can also contain may comprise at least one the heteroelement[[s]] selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal, ~~preferably W or Mo.~~

36. (Canceled).

37. (Currently Amended) The process as recited in claim ~~36~~43, wherein said solvent is selected from the group consisting of an ~~ether~~, an aromatic solvent, and a mixture thereof.

38. (Canceled).

39. (Currently Amended) The process as recited in claim ~~38~~37, wherein said ether is chosen from the group consisting of: dialkyl ether, cyclic ether, cyclic-, and open-chain polyether.

40. (Currently Amended) The process as recited in claim ~~36~~43, wherein said reducing agent is a base metal.

41. (Original) The process as recited in claim 40, wherein said base metal is chosen from the group consisting of: sodium, potassium and caesium.

42. (Currently Amended) The process as recited in claim ~~36~~43, wherein said isolating step is performed by one of: crystallization, precipitation, ~~and~~or sublimation.

43. (Currently Amended) A process for preparing a dopant, comprising the steps of:

(a) reacting an inorganic metal salt of the central atom M with a free base of a ligand in an organic solvent in the presence of a reducing agent and heating to reflux,

(b) isolating the dopant product obtained after reacting and drying, the [A] ligand for a metal complex, being selected from the group consisting of:



Type 65a'

wherein the structural elements a-e can mean: a [[=]] is -CR₁R₂- or -NR-, b [[=]] is -CR₃R₄- or -NR-, c [[=]] is -CR₅R₆- or -SiR₅R₆-, d [[=]] is -CR₇R₈- or -NR-, and e [[=]] is -CR₉R₁₀- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, and R₁₀ are selected independently from, at the same time or independently of one another, H, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR, preferably R₄, R₅, R₆, R₇, R₉ = H and R₂, R₃, R₆, R₈, R₁₀ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, wherein the structure 65a' with when R₁ to R₁₀ [[=]] are H is excluded from this, wherein the structure 65a' with wherein R₁ and R₂ [[=]] are aryl is excluded from this, wherein in the structure 65a' R₁ and R₁₀ are always H,

wherein a or b or c or d can be NR with R [[=]] is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl,

a and d or b and c can be NR with R = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, wherein

at c, C is replaced by Si;

wherein the bonds b-d and c-e or b-d and a-c ~~can~~may, at the same time or independently of one another, be unsaturated,

wherein the bonds b-d, a-c, and c-e ~~can~~may, at the same time or independently of one another, ~~becompr~~comprise part of a saturated or unsaturated ring system which ~~can also contain the heteroelements~~may also comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein the ligand with wherein c-e [(=)] is selected from cyclohexyl and/or cyclohexenyl is excluded from this, or

wherein the bonds b-d, a-c and c-e ~~can~~may, at the same time or independently of one another ~~becompr~~comprise part of an aromatic or condensed aromatic ring system which ~~can also contain the heteroelements~~may also comprise a heteroelement selected from the group consisting of: O, S, Se, and N, wherein the ligand in which b-d, a-c, and c-e are components of benzene is excluded from this,

wherein the atom E is an element from the main group, ~~preferably selected from the group N, P, As, Sb, though without being limited to these,~~

wherein the structural element a-E-b ~~can be may~~ comprise a component of a saturated or unsaturated ring system which ~~can also contain the heteroelements~~may also comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, or

the structural element a-E-b ~~can optionally be may~~ comprise a component of an aromatic ring system which ~~can also contain the heteroelements~~may also comprise a heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal, ~~preferably W or Mo;~~



wherein the structural elements a-f can mean: a $[[=]]$ is $-CR_1R_2-$ or $-NR_2-$, b $[[=]]$ is $-CR_3R_4-$ or $-NR_2-$, c $[[=]]$ is $-CR_5R_6-$ or $-SiR_3R_6-$, d $[[=]]$ is $-CR_7R_8-$ or $-CR_7R_8-$, e $[[=]]$ is $-CR_9R_{10}-$ or $-NR_2-$, and f $[[=]]$ is $-CR_{11}R_{12}-$ or $-NR_2-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}$, and R_{12} are selected independently from hydrogen, C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, $-NR_2$ or $-OR$, preferably $R_{11}, R_{13}, R_{15}, R_{17}, R_{19}, R_{21} = H$ and $R_{23}, R_{25}, R_{27}, R_{29}, R_{31} = C_1$ - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, $-NR_2$ or $-OR$, wherein the structure 65b with wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}$, and $R_{12} [[=]]$ are H being is excluded from this, wherein the ligand with wherein R_9, R_{10}, R_{11} , and $R_{12} [[=]]$ are selected independently from phenyl, methyl, allyl, $RSCH_2-$ and $ROCH_2-$ being is excluded from this, wherein the ligand with wherein $R_9 [[=]]$ is phenyl, $R_{10} [[=]]$ is H, $R_{11} [[=]]$ is phenyl, and $R_{12} [[=]]$ is H being is excluded from this, wherein the ligand with wherein $R_1 [[=]]$ is phenyl being is excluded from this, wherein the ligand with wherein R_5, R_6, R_7 , and $R_8 [[=]]$ are phenoxy being is excluded from this,

wherein in the structural elements e and/or d, C can be replaced by Si,

wherein a or b or e or f can be NR with R $[[=]]$ is selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, or heteroaryl,

wherein a and f or b and e can be NR with R = C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl,

wherein the bonds a-c, b-d, c-e, and d-f, but not simultaneously a-c and c-e and not simultaneously b-d and d-f, can may be unsaturated,

wherein the bonds a-c, b-d, c-e, and d-f can may comprise part of a saturated or unsaturated ring system which can also contain the heteroelements may also comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein

the bonds a-c, b-d, c-e, and d-f can may comprise part of an aromatic or condensed aromatic ring system which can also contain the heteroelements may also comprise a

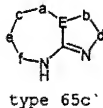
heteroelement selected from the group consisting of: O, S, Se, and N, wherein the ligand in which a-c, b-d, c-e, and d-f are components of benzene being is excluded from this,

wherein the atom E is an element from the main group, preferably selected from the group N, P, As, Sb, though without being limited to these,

wherein the structural element a-E-b can may comprise a component of a saturated or unsaturated ring system which can also contain the heteroelements may also comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, excluding from this the ligand with wherein a-E-b [] comprises a component of a cyclopentyl and pyranyl structure wherein with R₉, R₁₀, R₁₁, and to R₁₂ [] are alkyl,

wherein the structural element a-E-b can may comprise a component of an aromatic ring system which can also contain the heteroelements may also comprise a heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is one of W, Mo, and a transition metal;



wherein the structural elements a-f can mean: a [] is -CR₁R₂- or -NR-, b [] is -CR₃R₄- or -NR-, c [] is -CR₅R₆- or -SiCR₅R₆-, d [] is -CR₇R₈- or -NR-, e [] is -CR₉R₁₀- or -SiCR₉R₁₀-, and f [] is -CR₁₁R₁₂- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, and R₁₂ can, at the same time or independently from one another, be independently selected from H, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR, preferably R₁, R₃, R₅, R₇, R₉, R₁₁ = H and R₂, R₄, R₆, R₈, R₁₀, R₁₂ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, wherein the ligand with wherein R₁ to R₁₂ [] are H being is excluded from this, or

~~at e or e, C can be replaced by Si,~~

~~wherein a or b or d or f can be NR with R [=] is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl,~~

~~wherein a and d or b and f can be NR with R = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl,~~

~~wherein the bonds a-c, c-e, e-f₂ and b-d, but not simultaneously a-c, c-e, and e-f₂ and not simultaneously a-c and c-e, and not simultaneously c-c and e-f₂ can may be unsaturated,~~

~~wherein the bonds a-c, c-e, e-f₂ and b-d can be may comprise part of a saturated or unsaturated ring system which can also contain the heteroelements may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,~~

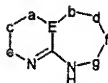
~~wherein the bonds a-c, c-e, e-f₂ and b-d can be may comprise part of an aromatic or condensed aromatic ring system which can also contain the heteroelements may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N, wherein the ligand with wherein the structure is excluded when E [=] is N and simultaneously e-f and/or b-d as comprise part of benzene or naphthalene being excluded from this, wherein the ligand with wherein E [=] is N and simultaneously R₇ [=] and R₈ [=] are phenyl being is excluded from this, wherein the ligand with wherein E [=] is N and R₃ [=] is phenyl or [,] benzyl being is excluded from this~~

~~wherein the atom E is an element from the main group, preferably selected from the group N, P, As, Sb, though without being limited to these, wherein the ligand with wherein E [=] is N and simultaneously the seven-membered ring with comprises more than one unsaturated bond being is excluded from this~~

~~wherein the structural element a-E-b can optionally be may comprise a component of a saturated or unsaturated ring system which can also contain the heteroelements may comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,~~

wherein the structural element a-E-b can optionally be may comprise a component of an aromatic ring system which can also contain the heteroelements may comprise a heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal, preferably W or Mo; or



Type 65d'

wherein the structural elements a-g can mean: a [[=]] is -CR₁R₂- or -NR-, b [[=]] is -CR₃R₄- or -NR-, c [[=]] is -CR₅R₆- or -SiR₅R₆-, d [[=]] is -CR₇R₈- or -SiR₇R₈-, e [[=]] is -CR₉R₁₀- or -NR-, f [[=]] is -CR₁₁R₁₂- or -SiR₁₁R₁₂-, and g [[=]] is -CR₁₃R₁₄- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, R₁₂, R₁₃ and R₁₄ can, at the same time or independently from one another, be are selected independently from H, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR, preferably, R₄, R₅, R₆, R₇, R₉, R₁₁, R₁₃ = H and R₂, R₃, R₈, R₁₀, R₁₂, R₁₄ = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂ or -OR, or at e, d and f, though not d and f simultaneously, C can be replaced by Si wherein d and f may not comprise -SiR₇R₈- and -SiR₁₁R₁₂- simultaneously, wherein a or b or e or g can be -NR- with R [[=]] is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl,

wherein a and g or b and e can be -NR- with R = C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl,

wherein the bonds a-c, c-e, b-d, d-f, and f-g, but not simultaneously a-c and c-e, and not simultaneously b-d, d-f, and f-g, and not simultaneously b-d and d-f, and not simultaneously d-f and f-g, can may be unsaturated, wherein the ligand in which b-d and f-g are simultaneously unsaturated being is excluded from this,

wherein the bonds a-c, c-e, b-d, d-f, and f-g ~~can~~ may comprise part of a saturated or unsaturated ring system which ~~can also contain the heteroelements~~ may comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the bonds a-c, c-e, b-d, and f-g ~~can~~ may comprise part of an aromatic or condensed aromatic ring system which ~~can also contain the heteroelements~~ may comprise a heteroelement selected from the group consisting of: O, S, Se, and N, wherein the ligand in which c-e and f-g are simultaneously comprise part of a benzene ring being ~~is excluded from this,~~

wherein the atom E is an element from the main group, ~~preferably selected from the group B, C, N, O, Si, P, S, As, Se, Te, particularly preferably selected from the group S, Se, N, P, though without being limited to these,~~

wherein the structural element a-E-b ~~can optionally~~ may comprise a component of a saturated or unsaturated ring system which ~~can also contain the heteroelements~~ may comprise a heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein the structural element a-E-b may comprise a component of an aromatic ring system which ~~can also contain the heteroelements~~ may comprise a heteroelement selected from the group consisting of: O, S, Se, and N, and

wherein the metal M is a transition metal, ~~preferably W or Mo.~~

44. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65a wherein R₁, R₃, R₅, R₇, and R₉ are H, and R₂, R₄, R₆, R₈, and R₁₀, are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

46. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65b wherein R₁, R₃, R₅, R₇, R₉, and R₁₁ are H, and R₂, R₄, R₆, R₈, R₁₀, and R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

47. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65b wherein a and f or b and e are -NR-.

48. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65c wherein R₁, R₃, R₅, R₇, R₉, and R₁₁, are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, and R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.
49. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65c wherein a and d or band f are -NR-.
50. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65d wherein R₁, R₃, R₅, R₇, R₉, R₁₁, and R₁₃ are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, R₁₂, and R₁₄ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.
51. (New) The dopant of claim 35, wherein the dopant has the structure of Type 65d wherein a and g or b and e are -NR-.
52. (New) The dopant of claim 35, wherein the element from the main group is selected from the group consisting of: N, P, As, and Sb.
53. (New) The dopant of claim 35, wherein M is selected from W or Mo.
54. (New) A semiconductive material comprising a metal complex according to claim 35, wherein the semiconductive material comprising a metal complex is in the form of an electrically contactable layer or of an electrical conduction path arranged on a substrate.
55. (New) The process of claim 43, wherein the ligand has the structure of Type 65a', wherein R₁, R₃, R₅, R₇, and R₉ are H, and R₂, R₄, R₆, R₈, and R₁₀ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.
56. (New) The process of claim 43, wherein the ligand has the structure of Type 65a', wherein a and d or b and e are -NR-.

57. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65b', wherein R_{11} , R_{13} , R_{15} , R_7 , R_9 , and R_{11} are H, and R_2 , R_4 , R_6 , R_8 , R_{10} , and R_{12} are selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, -NR₂, or -OR.

58. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65b', wherein a and f or b and e are -NR-.

59. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65c', wherein R_1 , R_3 , R_5 , R_7 , R_9 , and R_{11} are H, and R_2 , R_4 , R_6 , R_8 , R_{10} , and R_{12} are selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, -NR₂, or -OR.

60. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65c', wherein a and d or band f are -NR-.

61. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65d', wherein R_1 , R_3 , R_5 , R_7 , R_9 , R_{11} , and R_{13} are H, and R_2 , R_4 , R_6 , R_8 , R_{10} , R_{12} , and R_{14} are selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, -NR₂, or -OR.

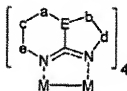
62. (New) The process of claim 43, wherein the ligand has the structure of 'Type 65d', wherein a and g or b and e are -NR-.

63. (New) The process of claim 43, wherein E is selected from N, P, As, Sb, B, C, O, Si, S, Se, or Te.

64. (New) The process of claim 43, wherein M is selected from W or Mo.

65. (New) A process for doping an organic semi-conducting matrix material, wherein the matrix material's electrical characteristics are altered, comprising the following steps:

a) combining with an organic semi-conducting matrix material, an effective amount of an n-dopant, wherein the n-dopant is a neutral electron-rich metal complex of formula:



Type 65a

wherein a is $-CR_1R_2-$ or $-NR-$, b is $-CR_3R_4-$ or $-NR-$, c is $-CR_5R_6-$ or $-SiR_5R_6-$, d is $-CR_7R_8-$ or $-NR-$, and e is $-CR_9R_{10}-$ or $-NR-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9,$ and R_{10} are selected independently from H, C_1-C_{20} alkyl, C_1-C_{20} cycloalkyl, C_1-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, heteroaryl, $-NR_2$, or $-OR$, wherein R is selected independently from C_1-C_{20} alkyl, C_1-C_{20} cycloalkyl, C_1-C_{20} alkenyl, C_1-C_{20} alkynyl, aryl, or heteroaryl;

wherein the bonds b-d and c-e or b-d and a-c may, at the same time or independently of one another, be unsaturated,

wherein the bonds b-d, a-c and c-e may, at the same time or independently of one another, comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

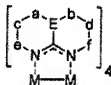
wherein the bonds b-d, a-c and c-e may, at the same time or independently of one another comprise part of an aromatic or condensed aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, or

the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal;



Type 65b

wherein a is $-\text{CR}_1\text{R}_2-$ or $-\text{NR}-$, b is $-\text{CR}_3\text{R}_4-$ or $-\text{NR}-$, c is $-\text{CR}_5\text{R}_6-$ or $-\text{SiR}_5\text{R}_6-$, d is $-\text{CR}_7\text{R}_8-$ or $-\text{SiR}_7\text{R}_8-$, e is $-\text{CR}_9\text{R}_{10}-$ or $-\text{NR}-$, and f is $-\text{CR}_{11}\text{R}_{12}-$ or $-\text{NR}-$, wherein $\text{R}_1, \text{R}_2, \text{R}_3, \text{R}_4, \text{R}_5, \text{R}_6, \text{R}_7, \text{R}_8, \text{R}_9, \text{R}_{10}, \text{R}_{11},$ and R_{12} are selected independently from hydrogen, $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_1\text{-C}_{20}$ cycloalkyl, $\text{C}_1\text{-C}_{20}$ alkenyl, $\text{C}_1\text{-C}_{20}$ alkynyl, aryl, heteroaryl, $-\text{NR}_2$, or $-\text{OR}$,

wherein R is selected independently from $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_1\text{-C}_{20}$ cycloalkyl, $\text{C}_1\text{-C}_{20}$ alkenyl, $\text{C}_1\text{-C}_{20}$ alkynyl, aryl, or heteroaryl, wherein

wherein the bonds a-c, b-d, c-e, and d-f, but not simultaneously a-c and c-e and not simultaneously b-d and d-f may be unsaturated,

wherein the bonds a-c, b-d, c-e, and d-f may comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

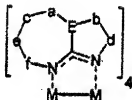
wherein the bonds a-c, b-d, c-e and d-f may comprise part of an aromatic or condensed aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is;



Type 65c

wherein a is $-CR_1R_2-$ or $-NR-$, b is $-CR_3R_4-$ or $-NR-$, c is $-CR_5R_6-$ or $-SiR_5R_6-$, d is $-CR_7R_8-$ or $-NR-$, e is $-CR_9R_{10}-$ or $-SiR_9R_{10}-$, and f is $-CR_{11}R_{12}-$ or $-NR-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11},$ and R_{12} are independently selected from hydrogen, C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, $-NR_2$, or $-OR$, wherein R is selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, or heteroaryl,

wherein the bonds a-c, c-e, c-f, and b-d, but not simultaneously a-c, c-e, and c-f, and not simultaneously a-c and c-e, and not simultaneously c-e and e-f, may be unsaturated,

wherein the bonds a-c, c-e, e-f, and b-d may comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

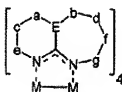
wherein the bonds a-c, c-e, e-f and b-d may comprise part of an aromatic or condensed aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal; or



Type 65d

wherein a is $-\text{CR}_1\text{R}_2-$ or $-\text{NR}-$, b is $-\text{CR}_3\text{R}_4-$ or $-\text{NR}-$, c is $-\text{CR}_5\text{R}_6-$ or $-\text{SiR}_5\text{R}_6-$, d is $-\text{CR}_7\text{R}_8-$ or $-\text{SiR}_7\text{R}_8-$, e is $-\text{CR}_9\text{R}_{10}-$ or $-\text{NR}-$, f is $-\text{CR}_{11}\text{R}_{12}-$ or $-\text{SiR}_{11}\text{R}_{12}-$, and g is $-\text{CR}_{13}\text{R}_{14}-$ or $-\text{NR}-$, wherein $\text{R}_1, \text{R}_2, \text{R}_3, \text{R}_4, \text{R}_5, \text{R}_6, \text{R}_7, \text{R}_8, \text{R}_9, \text{R}_{10}, \text{R}_{11}, \text{R}_{12}, \text{R}_{13}$, and R_{14} are independently selected from H, $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_1\text{-C}_{20}$ cycloalkyl, $\text{C}_1\text{-C}_{20}$ alkenyl, $\text{C}_1\text{-C}_{20}$ alkynyl, aryl, heteroaryl, $-\text{NR}_2$, or $-\text{OR}$, wherein d and f cannot be simultaneously $-\text{SiR}_7\text{R}_8-$ and $-\text{SiR}_{11}\text{R}_{12}-$, respectively,

wherein R is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl,

wherein the bonds a-c, c-e, b-d, d-f and f-g, but not simultaneously a-c and c-e, and not simultaneously b-d, d-f and f-g, and not simultaneously b-d and d-f, and not simultaneously d-f and f-g, may be unsaturated,

wherein the bonds a-c, c-e, b-d, d-f, and f-g may comprise part of a saturated or unsaturated ring system, which may comprise at least one heterocycle selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn.

wherein the bonds a-c, c-e, b-d and f-g may comprise part of an aromatic or condensed aromatic ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein the structural element a-E-b may comprise a component of an aromatic ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

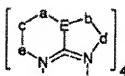
wherein the metal M is a transition metal.

66. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65a wherein R₁, R₃, R₅, R₇, and R₉ are H, and R₂, R₄, R₆, R₈, and R₁₀, are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

67. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65b wherein R₁, R₃, R₅, R₇, R₉, R₁₁ are H, and R₂, R₄, R₆, R₈, R₁₀, R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

68. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65b wherein a and f or b and e are -NR-.
69. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65c wherein R₁, R₃, R₅, R₇, R₉, R₁₁, are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.
70. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65c wherein a and d or b and f are -NR-.
71. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65d wherein R₁, R₃, R₅, R₇, R₉, R₁₁, and R₁₃ are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, R₁₂, and R₁₄ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.
72. (New) The dopant of claim 65, wherein the dopant has the structure of Type 65d wherein a and g or b and e are -NR-.
73. (New) The dopant of claim 65, wherein the element from the main group is selected from the group consisting of: N, P, As, and Sb.
74. (New) The dopant of claim 65, wherein M is selected from W or Mo.

75. (New) An electronic component comprising an electronically functionally effective region, wherein the electronically effective region comprises one or more neutral metal complexes wherein the metal complex has a structure selected from:



Type 65a

wherein a is $-\text{CR}_1\text{R}_2-$ or $-\text{NR}-$, b is $-\text{CR}_3\text{R}_4-$ or $-\text{NR}-$, c is $-\text{CR}_5\text{R}_6-$ or $-\text{SiR}_5\text{R}_6-$, d is $-\text{CR}_7\text{R}_8-$ or $-\text{NR}-$, and e is $-\text{CR}_9\text{R}_{10}-$ or $-\text{NR}-$, wherein $\text{R}_1, \text{R}_2, \text{R}_3, \text{R}_4, \text{R}_5, \text{R}_6, \text{R}_7, \text{R}_8, \text{R}_9$, and R_{10} are selected independently from H, $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_1\text{-C}_{20}$ cycloalkyl, $\text{C}_1\text{-C}_{20}$ alkenyl, $\text{C}_1\text{-C}_{20}$ alkynyl, aryl, heteroaryl, $-\text{NR}_2$, or $-\text{OR}$, wherein R is selected independently from $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_1\text{-C}_{20}$ cycloalkyl, $\text{C}_1\text{-C}_{20}$ alkenyl, $\text{C}_1\text{-C}_{20}$ alkynyl, aryl, or heteroaryl;

wherein the bonds b-d and c-e or b-d and a-c may, at the same time or independently of one another, be unsaturated,

wherein the bonds b-d, a-c and c-e may, at the same time or independently of one another, comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

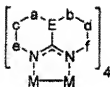
wherein the bonds b-d, a-c and c-e may, at the same time or independently of one another comprise part of an aromatic or condensed aromatic ring system which may also comprise the at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, or

the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal;



Type 65b

wherein a is -CR₁R₂- or -NR-, b is -CR₃R₄- or -NR-, c is -CR₅R₆- or -SiR₅R₆-, d is -CR₇R₈- or -SiR₇R₈-, e is -CR₉R₁₀- or -NR-, and f is -CR₁₁R₁₂- or -NR-, wherein R₁, R₂, R₃, R₄, R₅, R₆, R₇, R₈, R₉, R₁₀, R₁₁, and R₁₂ are selected independently from hydrogen, C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR,

wherein R is selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, or heteroaryl, wherein

wherein the bonds a-c, b-d, c-e, and d-f, but not simultaneously a-c and c-e and not simultaneously b-d and d-f may be unsaturated,

wherein the bonds a-c, b-d, c-e, and d-f may comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

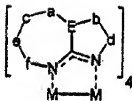
wherein the bonds a-c, b-d, c-e and d-f may comprise part of an aromatic or condensed aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is;



Type 65c

whereina is $-CR_1R_2-$ or $-NR-$, b is $-CR_3R_4-$ or $-NR-$, c is $-CR_5R_6-$ or $-SiR_5R_6-$, d is $-CR_7R_8-$ or $-NR-$, e is $-CR_9R_{10}-$ or $-SiR_9R_{10}-$, and f is $-CR_{11}R_{12}-$ or $-NR-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11},$ and R_{12} are independently selected from hydrogen, C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, $-NR_2$ or, $-OR$, wherein R is selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, or heteroaryl,

wherein the bonds a-c, c-e, e-f, and b-d, but not simultaneously a-c, c-e, and e-f, and not simultaneously a-c and c-e, and not simultaneously c-e and e-f, may be unsaturated,

wherein the bonds a-c, c-e, e-f, and b-d may comprise part of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

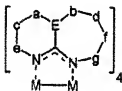
wherein the bonds a-c, c-e, e-f and b-d may comprise part of an aromatic or condensed aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the structural element a-E-b may comprise a component of an aromatic ring system which may also comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal; or



Type 65d

wherein a is $-CR_1R_2-$ or $-NR-$, b is $-CR_3R_4-$ or $-NR-$, c is $-CR_5R_6-$ or $-SiR_5R_6-$, d is $-CR_7R_8-$ or $-SiR_7R_8-$, e is $-CR_9R_{10}-$ or $-NR-$, f is $-CR_{11}R_{12}-$ or $-SiR_{11}R_{12}-$, and g is $-CR_{13}R_{14}-$ or $-NR-$, wherein $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}$, and R_{14} are independently selected from H, C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, heteroaryl, $-NR_2$ or $-OR$, wherein d and f cannot be simultaneously $-SiR_7R_8-$ and $-SiR_{11}R_{12}-$, respectively, wherein R is selected independently from C_1 - C_{20} alkyl, C_1 - C_{20} cycloalkyl, C_1 - C_{20} alkenyl, C_1 - C_{20} alkynyl, aryl, or heteroaryl,

wherein the bonds a-c, c-e, b-d, d-f and f-g, but not simultaneously a-c and c-e, and not simultaneously b-d, d-f and f-g, and not simultaneously b-d and d-f, and not simultaneously d-f and f-g, may be unsaturated,

wherein the bonds a-c, c-e, b-d, d-f, and f-g may comprise part of a saturated or unsaturated ring system, which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn,

wherein the bonds a-c, c-e, b-d and f-g may comprise part of an aromatic or condensed aromatic ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the atom E is an element from the main group,

wherein the structural element a-E-b may comprise a component of a saturated or unsaturated ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, N, P, Si, Ge, and Sn, wherein the structural element a-E-b may comprise a component of an aromatic ring system which may comprise at least one heteroelement selected from the group consisting of: O, S, Se, and N,

wherein the metal M is a transition metal.

76. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65a wherein R₁, R₃, R₅, R₇, and R₉ are H, and R₂, R₄, R₆, R₈, and R₁₀, are selected independently C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

77. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65b wherein R₁, R₃, R₅, R₇, R₉, and R₁₁ are H, and R₂, R₄, R₆, R₈, R₁₀, and R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

78. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65b wherein a and f or b and e are -NR-.

79. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65c wherein R₁, R₃, R₅, R₇, R₉, and R₁₁, are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, and R₁₂ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

80. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65c wherein a and d or band f are -NR-.

81. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65d wherein R₁, R₃, R₅, R₇, R₉, R₁₁, and R₁₃ are hydrogen, and R₂, R₄, R₆, R₈, R₁₀, R₁₂, and R₁₄ are selected independently from C₁-C₂₀ alkyl, C₁-C₂₀ cycloalkyl, C₁-C₂₀ alkenyl, C₁-C₂₀ alkynyl, aryl, heteroaryl, -NR₂, or -OR.

82. (New) The dopant of claim 75, wherein the dopant has the structure of Type 65d wherein a and g or b and c are -NR-.

83. (New) The dopant of claim 75, wherein the element from the main group is selected from the group consisting of: N, P, As, and Sb.

84. (New) The dopant of claim 75, wherein M is selected from W or Mo.

85. (New) The electronic component according to claim 75, wherein the electronically effective region comprises an organic semi-conducting matrix material which is n-doped by at least one of the metal complexes.

86. (New) The organic semiconductive material according to claim 85, wherein the molar doping ratio of dopant to matrix molecule or the doping ratio of dopant to monomeric units of a polymeric matrix molecule is between 1:1 and 1:100,000.

87. (New) The electronic component according to claim 85, wherein the electronic component is an organic light-emitting diode, a photovoltaic cell, an organic solar cell, an organic diode, or an organic field-effect transistor, wherein the semi-conducting organic material doped with the at least one or more neutral metal complex is an electronically functionally effective region of the electronic component.

88. (New) The electronic component of claim 75, wherein the metal complex comprises an injection layer in the electronic component.